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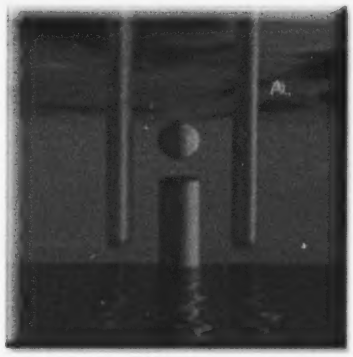
Canadian Labour Productivity Differences Across Firm Size Classes, 2002 to 2008



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...	not applicable
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^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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The Canadian Productivity Review

The Canadian Productivity Review is a series of applied studies that address issues involving the measurement, explanation, and improvement of productivity. Themes covered in the review include, but are not limited to, economic performance, capital formation, labour, prices, environment, trade, and efficiency at both national and provincial levels. The Review publishes empirical research, at different levels of aggregation, based on growth accounting, econometrics, index numbers and mathematical programming. The empirical research illustrates the application of theory and techniques to relevant public policy issues.

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Abstract

This paper examines differences in labour productivity across small, medium- and large-sized enterprises in Canada.

In 2008, the level of labour productivity, as measured by nominal gross domestic product per hour worked, in large businesses was greater than that for medium-sized and small businesses. This gap between large businesses relative to small and medium-sized businesses narrowed slightly during the post-2000 period.

The paper also examines the impact of changes in industrial structure on labour productivity. A 10% increase in the employment share of large businesses (similar to the change over the post-2000 decade) is estimated to have a relatively small impact on the level of productivity (2%).

Executive summary

This paper examines how firm size affects estimates of aggregate labour productivity. The business sector is divided into small-, medium- and large-sized enterprises. Estimates of labour productivity are generated for each group.

Labour productivity is an indicator of the efficiency with which labour is used in the production process. Differences in labour productivity arise from differences in the scale of production, the amount of capital available per worker, the skills possessed by owners, and other organizational characteristics (including technology) possessed by firms (see Baldwin et al. (2008) for a discussion of the determinants of differences in labour productivity).

In 2008, the level of productivity, as measured by nominal gross domestic product (GDP) per hour worked, was much greater for large ($72) than for medium-sized ($42) and small businesses ($35). The gap is widest in industries where large firms are more prevalent.

For capital-intensive industries (mining and oil and gas, utilities, manufacturing, transportation, and information), nominal GDP per hour worked in large businesses is relatively higher than in medium-sized and small businesses.

Over the 2002-to-2008 period, the gap between small and large firms in GDP per hour worked narrowed, particularly in industries where large firms were less prevalent.

Increases in average firm size might be expected to affect overall productivity. However, if the share of employment in large firms increased by 10%, aggregate labour productivity would rise by only an estimated 2%.

1 Introduction

Discussions of Canada's economic performance have asked whether changes in industrial structure towards larger firms would have a positive impact on productivity levels. Because larger firms are generally more productive than small firms, shifts in the firm size distribution toward larger firms might be expected to have a favourable impact on overall productivity.

Productivity gaps between small and large firms have been attributed to a number of factors: scale economies related to plant size; shorter production runs; higher prices of capital relative to labour that give rise to differences in capital per worker; and differences in managerial efficiency.

The factors behind and the effect of Canada's relatively large concentration of smaller firms have been investigated by a number of researchers (Baldwin and Gorecki 1986; Inwood and Keay 2005; Leung, Meh and Terajima 2008).[1] The issue is usually approached indirectly by developing estimates of improvements in labour productivity that derive from being able to exploit scale economies, and by then correcting for the impact of differences in firm or plant size on estimates of the relative levels of labour productivity.

Previous studies have been limited by a lack of comprehensive data on differences in productivity across firm size classes. This paper overcomes that limitation by developing the first set of Gross Domestic Product (GDP) estimates by firm size and combining them with estimates of employment in order to generate labour productivity estimates by firm size for an extensive set of industries. The effects of shifts in the distribution of firm size on overall productivity is assessed. The study covers the 2002-to-2008 period. GDP per hour worked is used as the measure of labour productivity.[2]

The study builds on Leung and Rispoli (2012) who estimate the contributions to GDP made by small, medium-sized and large businesses from 2001 to 2008. A firm, or business, in this study is defined as all units controlled by a parent firm. Firms are classified by the employment of the ultimate parent: small firms have 0 to 99 employees; medium-sized firms, 100 to 499 employees; and large firms, 500 or more employees. The contribution of large firms to business sector GDP increased steadily from 44.4% in 2002 to 47.9% in 2008. Small and medium-sized firms accounted for the other 52.1% of business sector GDP in 2008. The resource boom figures prominently in explaining how the contribution of large firms in the mining and oil and gas industry increased. The developments in mining and oil and gas outweighed the impact of the challenges in manufacturing, an industry where large firms have dominated historically.

The present study extends the analysis to examine labour inputs (measured by hours worked) and aggregate labour productivity for each firm size class. In Canada, large firms in the corporate sector are more capital intensive than are small and medium-sized firms. The paper, therefore, investigates how labour productivity differs across firm size classes and how it changed over the period. This information is also used to investigate the magnitude of changes in aggregate productivity that would be expected to accompany changes in the distribution of firm size. This exercise is intended to inform the debate on whether an increase in the

1. Baldwin and Gorecki (1986) and Leung, Meh and Terajima (2008) attribute about half of the difference in Canada–United States manufacturing productivity to differences in firm size for the 1970s and 1990s, respectively Inwood and Keay (2005) also find that differences in firm size contributes about half the difference for the 1870s.
2. Compared with measures of output like sales, GDP is more complete, because it measures value added, the unduplicated value of goods and services generated by labour and capital. The key difference between a firm's sales and its GDP is the amount of intermediate inputs used by the firm. A firm could have high sales but low GDP because it adds little to the value of the intermediate inputs it purchases.

percentage of large firms might be expected to have much influence on Canadian productivity levels.

2 Methodological issues

2.1 Coverage

In Canada, the business sector comprises all corporate businesses and unincorporated businesses that are organized for profit, and that produce goods and services for sale at a price intended to at least approximate the costs of production. Government business enterprises are included as part of this definition. The business sector accounted for 78.2% of total GDP in Canada in 2008.[3]

2.2 Definition of productivity

The focus is labour productivity, an indicator of the efficiency with which the economy uses labour to produce goods and services. Labour productivity will be higher in sectors where workers have more capital, and where firms exploit economies of scale, employ more skilled workers, or use more advanced technologies.

Labour productivity is defined here as output per unit of labour input. Output is measured using GDP calculated at basic prices. Labour input is measured using hours worked. The labour productivity of industry *i* is the weighted average of the labour productivity in the small, medium-sized and large business categories for industry *i*, where the weights are the share of hours for each business-size category in industry *i*.

$$LP_i = \sum_j LP_{ij} \frac{H_{ij}}{H_i}, \tag{1}$$

where LP represents labour productivity, H represents hours worked, and j indexes the business size categories. Labour productivity for the business sector as whole is the summation across all industries of the labour productivity of an industry multiplied by its share of business sector hours worked:

$$LP = \sum_i LP_i \frac{H_i}{H}. \tag{2}$$

2.3 Measurement of gross domestic product

Business sector GDP is measured at basic prices and in nominal terms. Value added in the Input-Output Accounts is one of several GDP measures produced in the Canadian System of National Accounts. Value added in the Input-Output Accounts is the sum of gross value added of all resident producer units.[4]

3. Other sectors of the domestic economy, including government and the non-profit sector (households and institutions), are part of the non-business sector. In this paper, the non-business sector is comprised of government administration (federal, provincial and municipal), defense, hospitals, public education, government residential care facilities, non-profit activity, and the rent that is imputed to owner-occupied housing.
4. The Input-Output Accounts are calculated on an establishment basis. This paper defines the units of interest at the level of the ultimate parent.

The Input-Output Accounts provide estimates of GDP at the industry or national level, but they are not available by firm size. To obtain measures of the income components of GDP by industry and by firm size, data from several sources are used to estimate the components included in the industry aggregates: wages and salaries; portions of supplementary labour income; other operating surplus; and indirect taxes less subsidies.

This study generally relies on administrative data from the Canada Revenue Agency (CRA). The General Index of Financial Information income statements included with the T2 corporate tax filings of firms are the main data source used to generate measures of revenue and operating surplus and indirect taxes on production less subsidies. The main data source for labour income is the T4 Statement of Remuneration Paid forms issued by every business to its employees for income tax purposes. The employment of each firm is obtained from PD7 payroll deduction accounts.

The estimates for the firm size classes are derived from Leung and Rispoli (2012). Each location in the firm is allocated to a size class based on the employment size of the commonly controlled group of enterprises (ultimate parent) to which it belongs, and all locations are summed to provide an estimate of the GDP of the ultimate parent.[5]

The resulting shares across firm sizes for each component of GDP are benchmarked industry by industry to the Input-Output Accounts.[6] The aggregate estimates for the business sector are the sum of the benchmarked industry estimates.

2.4 Measurement of labour input

Labour input in this analysis is measured as hours worked for paid workers, as well as, for the unincorporated self-employed.

This is calculated in two steps for paid workers—first, with an estimate of jobs, and then, with an estimate of hours worked per job. The product of the two yields an estimate of total hours worked for paid workers.

In the first step, hours worked are estimated for paid workers. This requires an estimate of jobs of paid workers by firm size. The estimate is derived from the Payroll Deductions file (PD7) (business sector only) and benchmarked to the major industry level to number of jobs, as published by Statistics Canada's Productivity Accounts.

The CRA requires that each employer open and maintain a payroll account and be responsible for deducting, remitting and reporting payroll deductions for each employee. This account has the employer's Business Number (BN), a unique identifier assigned by the CRA. Some enterprises have simple business structures, in which the enterprise and establishment are the same, and generally have only one BN. By contrast, complex enterprises may have many BNs. In such cases, allocation of employment to locations is based on the structure of the enterprise, which is taken from the Business Register.

In the second step, hours worked per paid worker are estimated by firm size and industry using the Labour Force Survey.

5. The Business Register is used to map all information from the above data sources to the appropriate ultimate parent enterprise group, the concept of the firm used in Leung, Rispoli and Gibson (2011) and in this study. An enterprise is a legal entity or group of consolidated legal entities associated with a complete set of financial statements. An ultimate parent enterprise group is a group of enterprises controlled through majority ownership by a common enterprise, the ultimate parent enterprise.
6. The differences between the micro file and the Input-Output Accounts were relatively small. The sum of all differences at the industry level was 3.8 percent of total labour income and 5.2 percent of capital income.

Total hours of paid workers are calculated as the product of jobs and hours worked per job. These are benchmarked to the business sector hours worked by paid workers by industry, as published by Statistics Canada's Productivity Accounts.

Finally, total hours worked by the unincorporated self-employed are taken from the Productivity Accounts. For this analysis, all the unincorporated self-employed are placed in the small-firm category.

3 Importance of small, medium and large firms

3.1 Gross domestic product

Over the 2002-to-2008 period, the share of small firms in GDP declined. Small and medium-sized firms generated 55.6 % of business sector GDP in 2002; this fell to 52.1% in 2008 (Tables 1 and 2). The GDP of small firms grew 5.3% per year on average over this period, and of medium-sized firms, 3.4% per year. The output growth in both groups was less than the 7.3% annual growth rate of large firms.

Large firms' share of GDP differed considerably across industries, ranging from less than 4% in agriculture to 93% in utilities (Table 3). Industries whose large-firm share of GDP surpassed 40% throughout the 2002-to 2008-period were: utilities; mining and oil and gas; information and culture; manufacturing; transportation; arts and entertainment; and finance and real estate.

Table 1

Business sector nominal gross domestic product, by firm size, Canada, 2002 and 2008

Firm size	Gross domestic product			Share of business sector	
	2002	2008	Average growth	2002	2008
	millions of nominal dollars		percent	percent	percent
Small	344,372	469,518	5.3	42.2	40.6
Medium	108,969	133,040	3.4	13.4	11.5
Small and medium	453,341	602,558	4.9	55.6	52.1
Large	362,354	554,192	7.3	44.4	47.9

Note: Gross domestic product estimates exclude gross domestic product from owner-occupied dwellings.
Source: Statistics Canada, authors' calculations.

Table 2

Distribution of business sector nominal gross domestic product, by firm size, Canada, 2002 to 2008

Firm size	Share of business sector						
	2002	2003	2004	2005	2006	2007	2008
	percent						
Small	42.2	41.7	41.3	40.6	40.0	40.3	40.6
Medium	13.4	12.7	12.4	12.3	12.2	12.2	11.5
Small and medium	55.6	54.4	53.7	52.9	52.2	52.6	52.1
Large	44.4	45.6	46.3	47.1	47.8	47.4	47.9

Source: Statistics Canada, authors' calculations.

The most notable increase in the share of GDP produced in large firms was in mining and oil and gas, where the large-firm share rose by 13.6 percentage points from 69.3% in 2002 to

82.9% in 2008. The growth of large businesses in mining and oil and gas occurred during the resource boom. A number of industries experienced more moderate increases (6 to 8 percentage points) in their large-firm contributions to GDP: transportation, finance and real estate, information and culture, wholesale trade, and administrative services.

Table 3

Share of business sector nominal gross domestic product, by firm size and industry, Canada, 2002 and 2008

S-level aggregation based on North American Industry Classification	Firm size					
	Small		Medium		Large	
	2002	2008	2002	2008	2002	2008
	percent					
Higher large-firm concentration						
Utilities	2.9	2.6	4.1	4.8	93.0	92.6
Mining, oil and gas	12.6	8.6	18.1	8.5	69.3	82.9
Information	12.7	10.3	10.7	7.6	76.6	82.1
Manufacturing	20.2	25.5	18.7	18.3	61.0	56.2
Transportation	38.0	33.5	14.1	12.7	47.9	53.8
Arts and entertainment	42.3	39.6	13.0	10.4	44.8	49.9
Finance	48.7	44.8	8.9	6.9	42.4	48.3
Total	27.1	25.0	14.2	10.9	58.7	64.1
Lower large-firm concentration						
Retail	50.3	46.3	10.0	9.7	39.7	43.9
Wholesale	45.4	40.0	18.3	17.8	36.3	42.2
Administrative	48.5	44.2	19.0	15.6	32.4	40.3
Professional	57.3	57.4	13.5	12.7	29.2	29.9
Accommodation	63.6	61.5	17.2	15.5	19.2	23.0
Construction	78.0	72.7	9.9	13.2	12.0	14.1
Other services	80.8	81.0	6.7	7.9	12.5	11.0
Education	74.7	79.1	7.8	10.1	17.6	10.9
Health	84.8	82.4	7.6	6.8	7.6	10.8
Agriculture	90.0	92.8	3.9	3.7	6.2	3.5
Total	63.3	60.6	12.2	12.3	24.5	27.1
Business sector	42.2	40.6	13.4	11.5	44.4	47.9

Source: Statistics Canada, authors' calculations.

Some industries—utilities, manufacturing, other services, education, and agriculture—experienced a decline in the large-firm share of GDP over the 2002-to-2008 period. The decline in the large-firm share in manufacturing is noteworthy, given manufacturing's substantial contribution to business-sector GDP. The decline in manufacturing GDP over the 2002-to-2008 period that coincided with the significant appreciation of the Canadian dollar relative to the U.S. dollar occurred mainly in large businesses. The share of large firms in manufacturing fell from 61% to 56%. The changes in manufacturing coincided with absolute declines in nominal GDP in this sector (Table 4). The GDP of large manufacturing businesses decreased at an average annual rate of 2.2% between 2002 and 2008. By contrast, small manufacturing businesses increased their GDP by an average of 3.1% per year.

Table 4

Business sector nominal gross domestic product, by firm size and industry, 2002 and 2008

S-level aggregation based on North American Industry Classification	Firm size								
	Small			Medium			Large		
	2002	2008	Average growth	2002	2008	Average growth	2002	2008	Average growth
	millions of nominal dollars		percent	millions of nominal dollars		percent	millions of nominal dollars		percent
Higher large-firm concentration									
Utilities	785	890	2.1	1,124	1,654	6.7	25,405	31,910	3.9
Mining, oil and gas	6,730	13,265	12.0	9,699	13,204	5.3	37,059	128,288	23.0
Information	4,627	5,082	1.6	3,869	3,787	-0.4	27,820	40,670	6.5
Manufacturing	36,982	44,317	3.1	34,214	31,764	-1.2	111,524	97,550	-2.2
Transportation	18,097	20,963	2.5	6,745	7,931	2.7	22,831	33,594	6.6
Arts and entertainment	3,527	4,219	3.0	1,083	1,107	0.4	3,736	5,315	6.0
Finance	58,133	73,611	4.0	10,630	11,265	1.0	50,625	79,397	7.8
Total	128,881	162,346	3.9	67,364	70,712	0.8	279,000	416,724	6.9
Lower large-firm concentration									
Retail	29,397	38,650	4.7	5,856	8,134	5.6	23,184	36,651	7.9
Wholesale	25,067	31,282	3.8	10,079	13,888	5.5	20,070	32,983	8.6
Administrative	12,025	16,554	5.5	4,719	5,830	3.6	8,038	15,092	11.1
Professional	27,637	41,774	7.1	6,502	9,262	6.1	14,061	21,774	7.6
Accommodation	16,036	20,166	3.9	4,331	5,085	2.7	4,848	7,540	7.6
Construction	45,087	78,261	9.6	5,733	14,169	16.3	6,954	15,174	13.9
Other services	15,070	20,329	5.1	1,247	1,987	8.1	2,336	2,767	2.9
Education	1,723	2,583	7.0	179	329	10.7	405	355	-2.2
Health	23,080	31,669	5.4	2,078	2,601	3.8	2,064	4,153	12.4
Agriculture	20,368	25,904	4.1	881	1,043	2.8	1,394	978	-5.7
Total	215,491	307,172	6.1	41,605	62,328	7.0	83,355	137,468	8.7
Business sector	344,372	469,518	5.3	108,969	133,040	3.4	362,354	554,192	7.3

Source: Statistics Canada, authors' calculations.

3.2 Hours worked

The growth rates of hours worked and GDP were similar across firm size classes. Like GDP, the increases from 2002 to 2008 in hours worked for large firms exceeded those for medium-sized and small firms. Total hours worked in large firms rose by 3.4% per year, compared with 1.0% per year for medium-sized firms and 0.6% per year for small firms (Table 5).

The similarities in the growth rates of hours worked and GDP across firm size classes prevails at the industry level. The industries with strong or moderate gains in the GDP share of large firms (mining and oil and gas, transportation, finance, wholesale trade, and administrative services) also showed stronger hours growth in the large-firm category. For example, in mining and oil and gas, the average growth rate in hours worked for large firms was 9.4%, compared with 3.7% for medium-sized firms, and 6% for small firms.

Table 5

Business sector hours worked, by industry and firm size, Canada, 2002 and 2008

S-level aggregation based on North American Industry Classification	Firm size								
	Small			Medium			Large		
	2002	2008	Average growth	2002	2008	Average growth	2002	2008	Average growth
	thousands of hours		percent	thousands of hours		percent	thousands of hours		percent
Higher large-firm concentration									
Utilities	10,806	11,072	0.4	8,899	10,705	3.1	145,838	165,805	2.2
Mining, oil and gas	96,164	136,457	6.0	63,964	79,317	3.7	170,143	291,804	9.4
Information	202,602	178,862	-2.1	86,346	82,226	-0.8	331,346	422,660	4.1
Manufacturing	1,409,188	1,275,669	-1.6	866,942	773,523	-1.9	1,633,955	1,406,754	-2.5
Transportation	683,801	661,076	-0.6	174,242	174,822	0.1	572,815	724,710	4.0
Arts and entertainment	268,195	288,664	1.2	47,663	48,311	0.2	99,111	122,003	3.5
Finance	646,763	723,368	1.9	168,646	169,167	0.1	840,548	1,038,617	3.6
Total	3,317,520	3,275,167	-0.2	1,416,702	1,338,071	-0.9	3,793,757	4,172,352	1.6
Lower large-firm concentration									
Retail	1,650,122	1,543,359	-1.1	303,144	329,032	1.4	962,172	1,260,983	4.6
Wholesale	946,926	904,616	-0.8	304,922	299,113	-0.3	382,876	507,102	4.8
Administrative	543,282	622,879	2.3	197,019	231,697	2.7	377,829	572,251	7.2
Professional	1,093,652	1,216,092	1.8	164,199	210,330	4.2	303,584	469,297	7.5
Accommodation	1,243,596	1,258,637	0.2	266,221	262,017	-0.3	185,714	279,823	7.1
Construction	1,579,738	2,026,473	4.2	167,916	315,256	11.1	169,376	289,674	9.4
Other services	976,204	1,005,057	0.5	60,629	72,100	2.9	89,589	103,886	2.5
Education	93,009	113,689	3.4	7,822	13,016	8.9	9,560	7,523	-3.9
Health	815,806	884,268	1.4	39,471	48,387	3.5	25,033	47,340	11.2
Agriculture	826,502	721,015	-2.3	36,858	29,360	-3.7	46,484	27,680	-8.3
Total	9,768,837	10,296,086	0.9	1,548,202	1,810,309	2.6	2,552,217	3,565,560	5.7
Business sector	13,086,357	13,571,253	0.6	2,964,904	3,148,380	1.0	6,345,974	7,737,911	3.4

Sources: Statistics Canada Labour Productivity Program, Payroll Deductions file (PD7) and authors' calculations.

Moreover, in industries where the large-firm share of GDP declined, growth of hours worked in large firms tended to be weaker than that in small and medium-sized firms. For example, in manufacturing, the average growth rate of hours worked in large firms was -2.5%, compared with -1.9% in medium-sized firms and -1.6% in small firms.

The relative share of hours worked in large businesses rose from 28.3% in 2002 to 31.6% in 2008 (Table 6). Similar to GDP, increases in the hours share of large businesses were highest in mining and oil and gas, wholesale trade, retail trade, finance, transportation, information, and administrative services. And the hours share of large businesses in manufacturing declined as did its GDP.

The share of hours worked in medium-sized firms was generally constant from 2002 to 2008. The two exceptions were in construction, where the share rose from 9% to 12%, and in mining and oil and gas where the share fell from 19% to 16%.

The share of hours worked of small firms declined overall from 58.4% to 55.5%. The largest declines were in transportation, information, construction, wholesale trade, retail trade, administrative, and accommodation.

Table 6

Share of business sector hours worked, by industry and firm size, Canada, 2002 and 2008

S-level aggregation based on North American Industry Classification	Firm size					
	Small		Medium		Large	
	2002	2008	2002	2008	2002	2008
	percent					
Higher large-firm concentration						
Utilities	6.5	5.9	5.4	5.7	88.1	88.4
Mining, oil and gas	29.1	26.9	19.4	15.6	51.5	57.5
Information	32.7	26.2	13.9	12.0	53.4	61.8
Manufacturing	36.0	36.9	22.2	22.4	41.8	40.7
Transportation	47.8	42.4	12.2	11.2	40.0	46.4
Arts and entertainment	64.6	62.9	11.5	10.5	23.9	26.6
Finance	39.1	37.5	10.2	8.8	50.8	53.8
Total	38.9	37.3	16.6	15.2	44.5	47.5
Lower large-firm concentration						
Retail	56.6	49.3	10.4	10.5	33.0	40.2
Wholesale	57.9	52.9	18.7	17.5	23.4	29.6
Administrative	48.6	43.7	17.6	16.2	33.8	40.1
Professional	70.0	64.1	10.5	11.1	19.4	24.8
Accommodation	73.3	69.9	15.7	14.6	11.0	15.5
Construction	82.4	77.0	8.8	12.0	8.8	11.0
Other services	86.7	85.1	5.4	6.1	8.0	8.8
Education	84.3	84.7	7.1	9.7	8.7	5.6
Health	92.7	90.2	4.5	4.9	2.8	4.8
Agriculture	90.8	92.7	4.1	3.8	5.1	3.6
Total	70.4	65.7	11.2	11.6	18.4	22.8
Business sector	58.4	55.5	13.2	12.9	28.3	31.6

Source: Statistics Canada, authors' calculations.

4 Nominal gross domestic product per hour worked by firm size

Large firms differ from small firms in terms of capital intensity. The growth that transforms small into large firms often involves the application of more capital per worker to mechanize processes or to develop intellectual capital (Caves and Pugel 1980). Larger firms are more likely to make intangible investments, such as in advertising, skill enhancement, and research and development.[7] As well, larger firms tend to hire workers with more education and skills and pay higher wages (Brown and Medoff 1989, and Morissette 1991). These practices lead to differences in labour productivity between large and small firms.

In 2008, as measured by nominal GDP per hour worked, labour productivity in large firms ($72) exceeded that in medium-sized ($42) and small firms ($35) (Table 7). The labour productivity of medium-sized firms was 59% that of large firms; the labour productivity of small firms was 48% that of large firms (Table 8).

In Canada, large firms have a greater presence in industries that require substantial capital than do small and medium-sized firms. Dividing industries into those with "higher large-firm concentration" (GDP shares for large firms of about 50% or more) and those with "lower large-firm concentration" roughly splits industries into those that are capital-intensive and those that are non-capital-intensive. The industries in the higher large-firm concentration group are infrastructure industries (utilities, information and transportation), resource-based industries (mining and oil and gas) and manufacturers that are heavy consumers of capital (Baldwin and Dixon 2008). The labour productivity of large firms in these industries was $100 per hour worked in 2008, more than twice that in industries where large firms are less dominant ($39).

7. See Baldwin and Hanel (2003, ch. 7) and Baldwin and Gellatly (2003, ch. 11) for a comparison of the innovation profiles of large and small firms.

Table 7

Nominal business sector gross domestic product per hour worked, by industry and firm size, Canada, 2002 and 2008

S-level aggregation based on North American Industry Classification	Firm size								
	Small			Medium			Large		
	2002	2008	Average growth	2002	2008	Average growth	2002	2008	Average growth
	dollars per hour		percent	dollars per hour		percent	dollars per hour		percent
Higher large-firm concentration									
Utilities	72.6	80.4	1.7	126.3	154.5	3.4	174.2	192.5	1.7
Mining, oil and gas	70.0	97.2	5.6	151.6	166.5	1.6	217.8	439.6	12.4
Information	22.8	28.4	3.7	44.8	46.1	0.5	84.0	96.2	2.3
Manufacturing	26.2	34.7	4.8	39.5	41.1	0.7	68.3	69.3	0.3
Transportation	26.5	31.7	3.1	38.7	45.4	2.7	39.9	46.4	2.5
Arts and entertainment	13.2	14.6	1.8	22.7	22.9	0.1	37.7	43.6	2.4
Finance	89.9	101.8	2.1	63.0	66.6	0.9	60.2	76.4	4.1
Total	38.8	49.6	4.1	47.5	52.8	1.8	73.5	99.9	5.2
Lower large-firm concentration									
Retail	17.8	25.0	5.8	19.3	24.7	4.2	24.1	29.1	3.2
Wholesale	26.5	34.6	4.6	33.1	46.4	5.8	52.4	65.0	3.7
Administrative	22.1	26.6	3.1	24.0	25.2	0.8	21.3	26.4	3.6
Professional	25.3	34.4	5.2	39.6	44.0	1.8	46.3	46.4	0.0
Accommodation	12.9	16.0	3.7	16.3	19.4	3.0	26.1	26.9	0.5
Construction	28.5	38.6	5.2	34.1	44.9	4.7	41.1	52.4	4.1
Other services	15.4	20.2	4.6	20.6	27.6	5.0	26.1	26.6	0.4
Education	18.5	22.7	3.5	22.9	25.3	1.6	42.4	47.2	1.8
Health	28.3	35.8	4.0	52.6	53.7	0.3	82.4	87.7	1.0
Agriculture	24.6	35.9	6.5	23.9	35.5	6.8	30.0	35.3	2.8
Total	22.1	29.8	5.2	26.9	34.4	4.2	32.7	38.6	2.8
Business sector	26.3	34.6	4.7	36.8	42.3	2.4	57.1	71.6	3.8

Source: Statistics Canada, authors' calculations

Table 8

Relative nominal business sector gross domestic product per hour worked, by industry and firm size, Canada, 2002 and 2008

S-level Aggregation based on North American Industry Classification	Firm size							
	Small			Medium			Large	
	2002	2008	Average growth	2002	2008	Average growth	2002	2008
				percent				
Higher large-firm concentration								
Utilities	42	42	0.0	73	80	1.7	100	100
Mining, oil and gas	32	22	-6.0	70	38	-9.7	100	100
Information	27	30	1.4	53	48	-1.8	100	100
Manufacturing	38	50	4.5	58	59	0.4	100	100
Transportation	66	68	0.5	97	98	0.1	100	100
Arts and entertainment	35	34	-0.6	60	53	-2.2	100	100
Finance	149	133	-1.9	105	87	-3.0	100	100
Total	53	50	-1.0	65	53	-3.3	100	100
Lower large-firm concentration								
Retail	74	86	2.6	80	85	1.0	100	100
Wholesale	51	53	0.9	63	71	2.1	100	100
Administrative	104	101	-0.5	113	95	-2.7	100	100
Professional	55	74	5.2	85	95	1.8	100	100
Accommodation	49	59	3.1	62	72	2.4	100	100
Construction	70	74	1.0	83	86	0.5	100	100
Other services	59	76	4.2	79	103	4.6	100	100
Education	44	48	1.6	54	54	-0.2	100	100
Health	34	41	2.9	64	61	-0.7	100	100
Agriculture	82	102	3.6	80	101	3.9	100	100
Total	68	77	2.3	82	89	1.4	100	100
Business sector	46	48	0.8	64	59	-1.4	100	100

Source: Statistics Canada, authors' calculations

Scale effects are sufficiently important that small firms in capital-intensive industries experience greater productivity disadvantages than firms elsewhere. In 2008, small firms were only 50% as productive as large firms in the industries where large firms were more important. However, in industries where large firms were less dominant, the labour productivity of small firms was 77% that of large firms.

Evidence suggests that nominal labour productivity increased in small and medium-sized firms relative to large firms in industries where smaller firms were more important. The labour productivity of small relative to large firms increased in 9 of the 10 industries in the "lower large-firm concentration" group. The growth rates of labour productivity for small and medium-sized firms surpassed those of large firms.

This catch-up phenomenon was less prevalent in industries where large firms were more important. The exception was manufacturing, where the catch-up was probably related to the declining fortunes of large manufacturers.

5 Effect of changes in size distribution on labour productivity

The tendency for small firms to be less productive than large firms has led analysts examining differences in Canadian and U.S. productivity levels to ask whether industrial structure might provide an explanation. A full answer to this question is beyond the scope of this study, as it would require a detailed comparison of Canada–United States firm-size differences by industry and a calculation of the proportion of the productivity difference attributable to differences in firm-size distributions.

Nonetheless, it is possible to shed some light on the issue by calculating the amount by which an arbitrary shift of total hours from small and medium-sized firms to large firms would increase average labour productivity, while holding constant the labour productivity of each size class.[8]

A counterfactual is created by arbitrarily increasing the large-firm share of hours worked and recalculating aggregate labour productivity, and expressing the new productivity level as a percentage of the original level. This is done by calculating average productivity for large firms and for small and medium-sized firms combined, and then, reweighting the two. Three scenarios are considered: hours shares for large firms are increased by 10%, 25% and 50% from those existing in 2002. To put these scenarios in context, over the 2002-to-2008 period, the hours share of large business in the Canadian business sector increased by about 10%.

The counterfactual is calculated for each industry separately and the results are summed to estimate the impact for the business sector overall (Table 9).[9] For the entire business sector,

8. No assumptions are made as to how this might happen. It could occur from shifting industry composition within the industry classifications in this study or from a shift in the underlying firm-size structure. A more detailed study of actual changes would have to examine each of these factors in order to gauge whether industry structure or actual firm size is the cause of productivity differences between Canada and the United States.
9. The hours share for large firms is increased by 10%, 25% and 50%, holding constant the labour productivity in each business size category. Equation (1) is used to calculate each industry's labour productivity under the different counterfactual scenarios. Equation (2) is then used to estimate the counterfactual business sector labour productivity. Conducting the analysis directly at the business sector level would mix two effects—changing industry composition across the industries and changing firm-size distributions. It should be recognized that this method still leaves a degree of industry compositional effects below the two-digit industries used herein.

increasing the hours share of large firms by 10%, 25% and 50% would increase productivity in 2002 by 2%, 4%, and 7%, respectively.[10]

In the "higher large-firm concentration" industries, changes in industrial structure have a substantial impact on labour productivity because of the wide gaps in productivity between small and large firms. In mining, labour productivity would increase by 4%, 9% and 18%, respectively, under the three scenarios. In manufacturing, it would increase by 3%, 8%, and 17%.

Table 9

Effect on labour productivity of counterfactual changes in firm size distribution, by industry, Canada

S-level aggregation based on North American Industry Classification	Actual 2002	10% increase	25% increase	50% increase	10% increase	25% increase	50% increase
	dollars per hour				percent		
Higher large-firm concentration							
Utilities	165.0	171.8	174.2	174.2	4.1	5.6	5.6
Mining, oil and gas	162.0	167.9	176.8	191.6	3.7	9.2	18.3
Information	58.5	61.5	65.8	73.1	5.0	12.4	24.9
Manufacturing	33.8	34.3	35.2	36.6	3.3	8.3	16.5
Transportation	33.3	33.8	34.4	35.5	1.3	3.3	6.6
Arts and entertainment	20.1	20.7	21.5	22.9	2.7	6.9	13.7
Finance	72.1	70.9	69.0	66.0	-1.7	-4.2	-8.5
Lower large-firm concentration							
Retail	20.0	20.2	20.5	21.0	1.0	2.5	5.0
Wholesale	33.8	34.3	35.2	36.6	1.7	4.2	8.4
Administrative	22.2	22.1	22.1	21.9	-0.2	-0.5	-1.0
Professional	30.9	31.2	31.8	32.7	1.2	3.0	6.0
Accommodation	14.9	15.0	15.2	15.6	0.9	2.3	4.6
Construction	30.1	30.2	30.4	30.7	0.4	0.9	1.8
Other services	16.6	16.6	16.8	17.0	0.5	1.2	2.5
Education	20.9	21.1	21.4	21.9	1.0	2.4	4.9
Health	30.9	31.1	31.3	31.7	0.5	1.2	2.4
Agriculture	24.9	24.9	25.0	25.0	0.1	0.3	0.6
Business sector	36.4	37.0	37.8	39.0	1.6	3.8	7.1

Source: Statistics Canada, authors' calculations.

In industries where large firms have a smaller presence and less of a productivity advantage, changes in the size distribution generally have much less impact. In construction, the first two scenarios lead to less than a 1% gain in productivity. The largest increases occur in wholesaling—2%, 4%, and 8%.

The results of these scenarios need to be set against estimates of the size of the productivity gap between Canada and the United States. Baldwin, Leung and Rispoli (2011) estimate that the gap in real business-sector GDP per hour worked in 1998 was about 12 percentage points—Canadian real GDP per hour worked at the end of the 1990s would have to have increased by about 10% to have closed the gap. About a third of this was due to sole

10. A reviewer has observed that this may provide an upper bound, if, in moving labour share from the small sector to the large, the least productive small firms closed down. In this case, the productivity gap between large and small firms might be expected to narrow as shares are shifted, and therefore, to decline as ever more share is transferred from small to large firms. A more extensive study of changes in structure is required to examine the importance of this phenomenon—whether changes in the importance of size classes are also accompanied by substantial changes in relative productivity or whether this is a second-order effect. For the type of decompositions required, see Baldwin and Gu (2006).

proprietorships in the unincorporated sector—a group classified here in the smallest firm size category.[11]

The changes derived from the counterfactual experiment would not eliminate this gap entirely, but they would reduce it. A 10%, 25% and 50% increase in the hours share of large firms would close the gap in 1998 by about 12%, 27% and 56%, respectively. But the Canada/U.S. labour productivity gap has widened substantially since 1998 and the increase in nominal labour productivity from an increase in large firms will therefore have less of an impact on the closing of the gap. Further detail on how this impact played out over the post 2000 period will be presented in a forthcoming research paper that compares GDP per hour worked in Canada and the United States over the 2002 to 2008 period (Baldwin, Leung, Rispoli, 2013).

11. Part of the differences in size may be due to differences in incorporation rates in Canada and the United States. The Canadian unincorporated sector was substantially less productive than the Canadian corporate sector and than the U.S. non-corporate sector (Baldwin, Leung and Rispoli 2011). The study suggests that relative nominal GDP to hours worked of sole proprietorships was about half of the corporate sector in 2005, while relative nominal GDP to hours worked of Canadian sole proprietorships was about two-thirds of U.S. sole proprietorships in 2005. No attempt is made here to examine whether part of the size differences in Canada stems from having more unincorporated firms.

6 Conclusion

Canada has often been described as having a lack of large firms, a consequence of which, it has been argued, is lower aggregate productivity. Analysis of this issue requires comprehensive and consistent data on firm-size distributions and differences in productivity levels across firm size classes. Until now, these data have not been available.

This study and related papers in this series (Rispoli 2009; Leung and Rispoli 2011) examine the importance of firm size by measuring the GDP generated, the employment provided, and consequently, the labour productivity by firm size class.

In 2008, productivity, as measured by nominal GDP per hour worked was $72 for large firms, well above that for medium-sized ($42) and small firms ($35).

Nominal GDP per hours worked of small and medium-sized firms is much lower than that of large firms for capital-intensive industries (mining and oil and gas, utilities, manufacturing, transportation and information).

Important changes occurred post-2002. First, large firms increased their share of both GDP and labour. Second, some of the differences between the labour productivity of large and small firms declined over the period—especially in industries where large firms were less important.

An examination of the effect of changes in industrial structure (distribution of hours worked across firm size categories within each industry) on labour productivity finds that a 10% increase in the hours share of large firms (similar to the change post-2002) would have a relatively small impact on Canadian labour productivity (2%), assuming that changes in relative hours worked in the different firm size classes are not accompanied by changes in the relative productivity of the different size classes.

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